

iC5000 Debugger & On-Chip Analyzer

V1.4

User Manual



iSYSTEM

Enabling Safer Embedded Systems

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Contents

Introduction	1
Important safety notice	2
Package content	3
Specifications	4
Operation.....	5
Device overview.....	5
Device description	5
Connecting the iC5000 to the target hardware	7
Grounding wire	7
Power Supply	7
Debug Adapter	7
Accessories	10
Power supplies and cables.....	10
Standard debug adapters.....	11
Declarations	12
Technical support	13

Introduction

The iC5000 BlueBox On-Chip Analyzer is a hardware and software platform designed for debugging and testing a wide range of embedded microcontroller platforms that are based on a variety of processor architectures.

Functionality can be further extended with the addition of the I/O Module, enabling the synchronous capture of analog and digital signals in parallel to trace information. Such capability is used for advanced debugging of complex applications together with our winIDEA Integrated Development Environment (IDE), as well as for thorough testing in conjunction with our testing environment testIDEA.

Complementing the hardware is a range of software which target three key areas of embedded development: debugging, timing-analysis and testing.

winIDEA – The winIDEA Integration Development Environment (IDE) delivers the visual insights required to debug your embedded application. At the simplest level, winIDEA provides all the usual functionality of an IDE, such as breakpoints, stepping and device programming. When supported by a target microcontroller, winIDEA can also visualize the timing and code coverage of the application via the trace interface, as well as combine data captured by the IOM6 accessories. Various third-parties also provide software tools to perform advanced worst-time-execution analysis based upon the data winIDEA can export. When a Real-Time Operating System (RTOS) is in use, the state of the RTOS and its tasks can also be visualized.

testIDEA – The testIDEA environment simplifies the development of unit tests for embedded applications. By making use of the winIDEA environment, this application makes it easy to locate source code functions and generate test cases for them. Tests are then executed using the Original Binary Code (OBC) method, testing the object code running on the target microcontroller. The tests, which are stored as YAML files, can easily be added to a project, maintained in a repository, and then automatically executed together with Continuous Integration (CI) tools such as Jenkins.

isystem.connect – There are times when it is more efficient to write a script to execute a task that requires many clicks within a visual development environment. This is where our Software Development Kit (SDK) isystem.connect comes in. The well-documented interface provides access to Python, Java, C++ and other languages so that any action available within winIDEA and testIDEA can be scripted. Scripts can also be executed directly from within winIDEA, thereby allowing the developer to extend its functionality.

iSYSTEM BlueBox solutions best run under iSYSTEM winIDEA™ IDE or within the Eclipse IDE environment through a plug-in. winIDEA™ is a native Microsoft® Windows® application and as such best performs on Windows 7 and Windows 10 platforms. It also runs on Linux operating system with help of Wine. All our software can be downloaded from the Downloads page at <http://www.isystem.com>.

Important safety notice

General safety instructions

Please read the following safety precautions carefully before putting this device to use to avoid any personal injuries, damage to the instrument, or to the target system.

Use this instrument only for its intended purpose as specified by this manual to prevent potential hazards.

Use included power cord and power supply

The enclosed power supply has been approved for use by iSYSTEM. Please contact iSYSTEM if you need to consider an alternative power.

Use grounding wire

Prior to applying power to either the BlueBox or the target, connect the device and the target system together with the included grounding wire. This is to avoid potential damage caused by any voltage difference between the device and the target system.

Use proper overvoltage protection

Please ensure proper protection to avoid exposing the BlueBox device or the operator to overvoltage surges (e.g. caused by thunderstorm, mains power).

Do not operate without cover

Do not operate the device with cover removed.

Avoid circuit and wire exposure

Do not touch exposed components or wires when the device is powered.

Do not operate with suspected damage

If you suspect damage may have occurred, the BlueBox device must be inspected by qualified service personnel before further operation.

Do not operate the device outside its rated supply voltage or environmental range

Consult with iSYSTEM before using equipment outside of the parameters provided in this manual.



This symbol is used within the manual to highlight further safety notices.

Package content

The standard iC5000 order is delivered with the following components:

iC5000 Base Unit including pre-assembled DTM module	25 cm 40-pin ribbon cable	Power supply
Ordering code: IC50000 + IC50020	Ordering code: IC50020-25	Ordering code: IC30000-PS
		
USB 2.0 cable	Ethernet cable	Grounding wire
Ordering code: BB-USB20-180	Ordering code: BB-ETHCAT5-200	Ordering code: BB-WIRE
		
winIDEA installation DVD	User manual	License request instructions

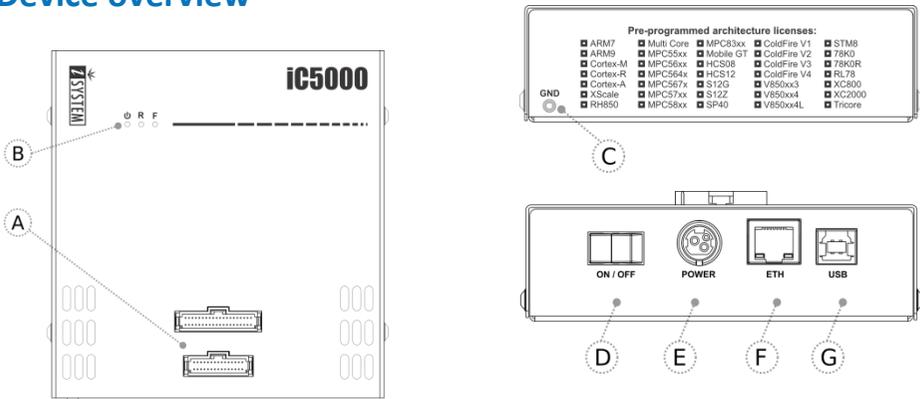


Specifications

GENERAL	
Operating temperature	10°C to 40°C
Storage temperature	-10°C to 60°C
Humidity	5% to 80% RH
MECHANICAL	
Size	122 x 127 x 45 mm (W x D x H)
Weight	approx. 500g
OPERATION	
Communication interfaces to PC	USB 2.0, 10/100 Mbps Ethernet
Supply voltage	10V to 24V DC
Power consumption	< 8W
ELECTRICAL	
Debug signal valid input voltage range	1.8V to 5.5V DC
Debug signals	47Ω series termination/protection resistors, ESD protection devices. Depending on the specific debug adapter, termination might be different from 47Ω on some critical signals.
All inputs except the TDO	10kΩ pull-up resistor
TDO input	10kΩ pull-down resistor
TMS and TDI debug signals	10kΩ pull-up resistor
RESET	1kΩ pull-up resistor, buffer-driven to prevent current flow into an unpowered iC5000 from a powered target board
TAR_VREF (target reference voltage) pin	100kΩ input impedance

Operation

Device overview



Device description

The top face of the iC5000 features two key areas; the DTM connectors **A** and the indicator lights **B**:

- **A** – The Debug Trace Module (DTM) provides two connectors, marked **#1** and **#2**. These connectors are the interface to the target microcontroller. Depending on the target microcontroller debug features, the supplied ribbon-cables will need to be connected to either connector **#1** only or connectors **#1** and **#2**.
- **B** – The indicator lights provide the status of the iC5000 hardware as follows:
 - **⏻** - Power Indicator – Green
 - On – powered on
 - Off – powered off
 - **R** - Running Indicator – Red
 - On – target microcontroller is executing code
 - Off – target microcontroller is halted
 - **F** - Free Indicator – Yellow
 - On – iC5000 is available for a connection from a host PC
 - Off – an active connection to the iC5000 from a host PC exists

The front face of the iC5000 features:

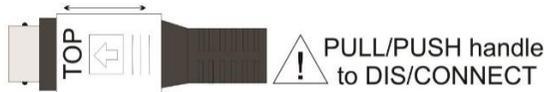
- **C** – The grounding socket (marked GND) should be used, together with the supplied Grounding Wire to create an electrical connection between the iC5000 and the target circuitry. The socket is suitable for a 2 mm Multi Contact Plug (also known as a Banana Plug) if building a longer or a replacement cable on your own.

The rear face of the iC5000 features the remaining connectors as follows:

- **D** – Power Switch

- **E** – Power Supply Socket

The socket and plug are latching to stop the plug from being accidentally pulled out of the socket. To remove the power plug from the socket, **always** pull gently of the sleeve of the plug and **never** on the wire.



- **F** – 10/100 Ethernet Socket

- **G** – USB 2.0 Socket

It is **recommended** to use the supplied USB 2.0 cable delivered with your iC5000 as it has been confirmed to fulfil the maximum USB 2.0 transfer rate. Use of alternate cables must be undertaken at your own risk.

Both the 10/100 Ethernet Socket and the USB 2.0 Socket can be connected to a network/PC simultaneously. The active interface will be determined by whichever interface winIDEA connects to first.

The USB 2.0 interface provides the highest possible data transfer rate of the two available interfaces. It is **highly recommended** to use the USB 2.0 when using the trace feature due to the quantity of data to be uploaded to the PC.



Information label with the MAC address and the serial number is placed on the bottom of your device.



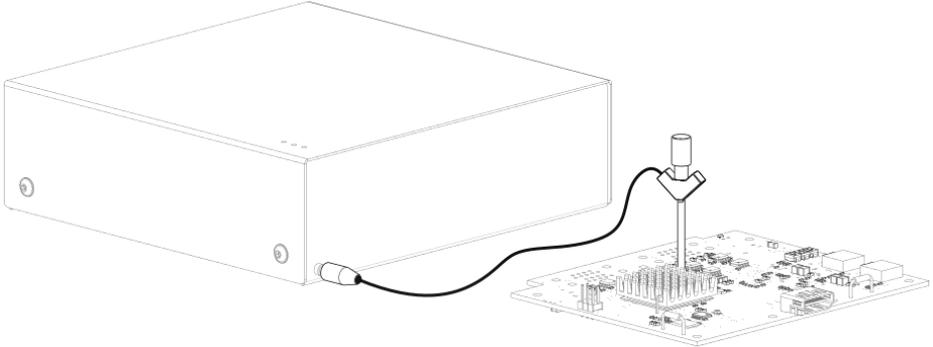
When powering on the system, switch the iC5000 on before powering on the target system. When powering down the system, power off the target before powering off the iC5000!

Use only original iSYSTEM accessories for powering and connecting with the iC5000. Consult with iSYSTEM before attempting to use any other accessory.

Connecting the iC5000 to the target hardware

Grounding wire

Always start by connecting the iC5000 to the target hardware with the enclosed grounding wire.



If the grounding wire is not connected, the ground potential difference between the BlueBox hardware and the target can exceed well over 1000V even before any of the devices are powered up. This voltage difference is discharged over the BlueBox hardware and the target system, leading to the possible destruction of electronic components within the BlueBox hardware, the target or both.

Power Supply

The iC5000 unit accepts a wide input voltage range from 10V to 24V DC, thus enabling the BlueBox hardware to work also with a 12V or 24V vehicle battery.

The necessary power supply (Part No. IC30000-PS) is delivered with the iC5700 unit. The power supply comes with the EU (type F power plug), USA (type B power plug), India (type D power plug) or China (type I power plug) power cord depending on the delivery address. Refer to the [Accessories](#) chapter for a spare power cord when required.

An optional 12V power supply adapter suitable for use in a vehicle can be ordered using the ordering code IC30000-PS-CAR12V.

Debug Adapter

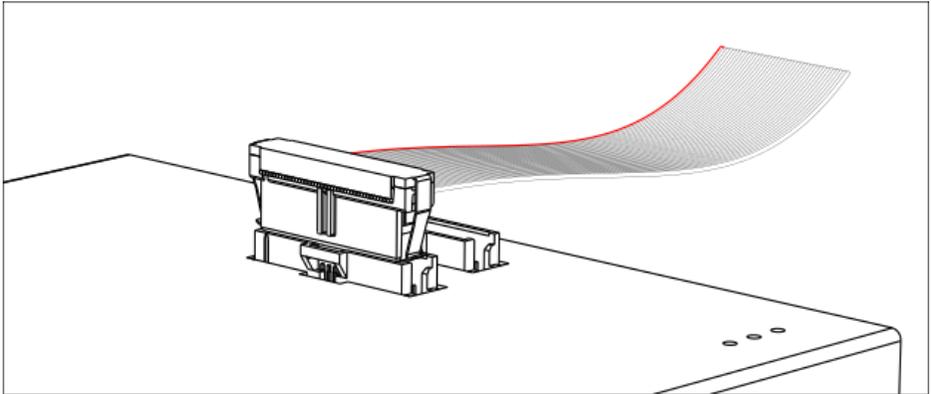
Depending on the target microcontroller, iSYSTEM will have supplied one of two different types of connection system to link the BlueBox hardware with the target microcontroller.

The first connection system consists of a single 40-pin ribbon cable together with a debug adapter suited to the debug connector of the target development board. The picture below shows an example of such debug adapter.



The debug adapter should be connected to one end of the 25-cm, 40-pin ribbon cable (included in your iC5000 delivery), with the other end being connected to the DTM #1 socket as described below:

1. Connect the 40-pin ribbon cable connector to the iC5000 DTM #1 socket.



The ribbon cable must **always** be guided towards the iC5000 front panel with the red wire on the side of the '#1' marking. Align the orientation key of the cable connector with the notch on the iC5000's 40-pin socket – the wider of the two sockets. Carefully press the cable connector straight down, keeping the connector parallel to the upper face of the iC5000, until the side latches lock.

2. Connect the debug adapter to the other end of the 25 cm 40-pin ribbon cable. Align the notch on the 40-pin debug adapter with the orientation key of the connector of the 40-pin ribbon cable. Press the cable carefully straight down until the latches lock.
3. Ensuring that both the iC5000 and target **are not powered**, and that the Ground Wire is **securely connected**, connect the debug adapter to the target system.



Do not use any excessive force when pressing the connector onto the target system's connector. The connector requires minimal force if it is correctly aligned. Observe the orientation key (either on the connector itself or implemented through a missing "key" pin) or the position of pin 1 as indicated by the ribbon cable's red marker wire!

To disconnect the ribbon cable, squeeze the two metal latches on the cable connector inwards and pull the connector gently from the socket.

If the delivered ribbon cable does not meet your needs, iSYSTEM offers a range of alternative lengths. Please refer to the [Accessories](#) chapter for available ribbon cables.

Note that the quality of electrical signals degrades with prolonging the cable. iSYSTEM gives no assurance for BlueBox operation with such cable. The cable is meant to be used only for boundary cases where BlueBox cannot be connected to the target hardware through the standard 25 cm long ribbon cable, for example due to the physical obstacles of the target system. In such cases, operating the BlueBox at lower JTAG scan speeds and not using the trace functionality at all, might be still an acceptable compromise. It's up to the user to thoroughly test and qualify the BlueBox operation using longer ribbon cable and to determine working winIDEA™ settings for his system.

The second connection system consists of two pin ribbon cables, one 30-pin and one 40-pin, with a permanently fitted debug adapter. An example of such adapter is shown below:



When fitting the ribbon cable to the iC5000, the connector must **always** be guided towards the iC5000 front panel with the red (edge) wire on the side of the '#1' or '#2' marking. Ensure the orientation key of the connector aligns with the notch on socket of the iC5000. Carefully press the cable connector straight down, keeping the connector parallel to the upper face of the iC5000, until the side latches lock.

1. Start by connect the 30-pin ribbon cable to the iC5000's #2 connector, being sure to use minimal force and following the advice given above.
2. Follow up by connecting the 40-pin ribbon cable to the iC5000's #1 connector, again being sure to use minimal force and following the advice given above.
3. Ensuring that both the iC5000 and target **are not powered**, and that the Ground Wire is **securely connected**, connect the connector at the opposite end of the ribbon cable to the target system.



Do not use any excessive force when pressing the connector onto the target system's connector. The connector requires minimal force if it is correctly aligned.

Observe the orientation key (either on the connector itself or implemented through a missing "key" pin) or the position of pin 1 as indicated by the ribbon cable's red marker wire!

To disconnect the ribbon cable, squeeze the two metal latches on the cable's connectors inwards and pull the connector gently from the socket.

Accessories

Power supplies and cables

Ensure proper operation of your iC5000 operation by using approved iSYSTEM power supplies and cables.

Ordering Code	Description
IC30000-PS	19V Power Supply including Power Cord
IC30000-PS-CAR12V	12V Car Power Supply
BB-PSC-EU	Power Supply Cord - EU Plug (type F Plug)
BB-PSC-US	Power Supply Cord - USA Plug (type B Plug)
BB-PSC-IN	Power Supply Cord - India Plug (type D Plug)
BB-PSC-CN	Power Supply Cord - China Plug (type I Plug)
IC50020-10	10 cm 40-pin Ribbon Cable
IC50020-25	25 cm 40-pin Ribbon Cable
IC50020-40	40 cm 40-pin Ribbon Cable
IC50020-60	60 cm 40-pin Ribbon Cable
IC50020-100	100 cm 40-pin Ribbon Cable
IC50020-150	150 cm 40-pin Ribbon Cable
BB-USB20-180	1.8 m USB 2.0 Cable
BB-ETHCAT5-200	2 m Cat 5 Ethernet Cable
BB-WIRE	Grounding Wire

Standard debug adapters

Various debug adapters are available to connect the iC5000 to a wide range debug connectors as commonly found on microcontroller development boards.

Ordering Code	Description
IC50111-1	20-pin 2.54mm ARM Debug Adapter
IC50112	14-pin 2.54mm ARM Debug Adapter
IC50113-AMP	20-pin 1.27mm AMP Cortex Debug Adapter
IC50115	38-pin Mictor ARM ETM 16-bit Debug Adapter
IC50116-2	10-pin 1.27mm Cortex Debug Adapter
IC50118-2	20-pin 1.27mm Cortex Debug Adapter
IC50119	20-pin 1.27 x 2.54mm Compact TI-20 Debug Adapter
IC50130 *1	26-pin 2.54 mm ColdFire Debug Adapter
IC50140 *1	6-pin 2.54mm BDM Debug Adapter
IC50141 *1	6-pin 2.54mm S12Z Debug Adapter
IC50150	14-pin 2.54mm MPC5xxx Debug Adapter
IC50152	38-pin Mictor MPC5xxx Nexus 16-bit Debug Adapter
IC50152-12	38-pin Mictor MPC5xxx Nexus 16-bit Debug Adapter, 12cm length
IC50153 *1	16-pin 2.54mm Freescale COP Debug Adapter
IC50155 *1	38-pin Mictor PPC4xx RISCTrace Debug Adapter
IC50156	50-pin Samtec MPC5xxx Nexus 16-bit Debug Adapter
IC50160	16-pin 2.54mm Infineon JTAG Debug Adapter
IC50160-ECU14	10-pin 1.27mm Tricore ECU14 Debug Adapter
IC50160-MEDC17	10-pin 1.27mm Tricore MEDC17 Debug Adapter
IC50162	6-pin 2.54mm Infineon I2C Debug Adapter
IC50163-2	10-pin 1.27mm Infineon DAP2 Wide Debug Adapter
IC50164	22-pin Samtec ERF8 DAP2 Debug Adapter
IC50170 *1	16-pin 2.54mm Renesas 78K0R Serial Debug Adapter
IC50171	20-pin 2.54mm Renesas V850/RH850 Debug Adapter
IC50172 *1	26-pin KEL Renesas V850 Debug Adapter
IC50174 *1	10-pin 2.54mm Renesas 78K0 Serial Debug Adapter
IC50175 *1	14-pin 2.54mm Renesas RL78 Serial Debug Adapter
IC50176	14-pin 2.54mm Renesas RH850 Debug Adapter
IC50176-EPS	10-pin 1.27mm Renesas RH850 Debug Adapter
IC50177	38-pin Mictor Renesas RH850 Nexus 16-bit Debug Adapter
IC50190 *1	4-pin ERNI ST STM8 Debug Adapter

*1 Note: Legacy microcontroller architecture is supported through this debug cable adapter. winIDEA build 9.12.288 is the last build supporting it.



More information can be found on our website at www.isystem.com or simply contact our sales team via sales@isystem.com

EU Declaration of Conformity (DoC)

We

iSYSTEM AG für Informatiksysteme
Carl-Zeiss-Str. 1
85247 Schwabhausen
Germany

declare that the DoC is issued under our sole responsibility and belongs to the following product:

Blue Box - debugger and analyzer solution
Type: iC3000, iC5000, iC5500, iC5700, iC6000, iTAG.2K

Identification allowing traceability:

Object of the declaration is identified by a product type and unique serial number for each individual device.

The object of declaration described above is in conformity with the relevant Union harmonization legislation:

EMC directive 2014/30/EU and RoHS directive 2011/65/EU

The following harmonized standards and technical specifications have been applied:

- EN 55032: 2012
- EN 55024: 2010
- EN 61000 - 3 - 2: 2014
- EN 61000 - 3 - 3: 2013

Signed for and on behalf of:



Martin Gröstenberger, CFO



Werner Fischer, COO

Schwabhausen, 21. March 2017

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Technical support

To reach for technical support, please visit www.isystem.com/support.

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